

Redescriptions of two Amphiisiellid Hypotrichs (Ciliophora: Hypotrichida: Amphiisiellidae) from Korea

Mann Kyoon Shin

(Department of Biological Science, University of Ulsan, Ulsan 680-749, Korea)

ABSTRACT

The amphiisiellid hypotrichs collected from the soils of pine forest, grassland and mosses at three localities from Kyonggi-do, Korea were identified as *Amphiisiella acuta* Foissner and *Orthoamphiisiella stramenticola* Eigner and Foissner. These species are newly recorded from Korea and redescribed with illustrations. The description was based on the observation of living specimens, protargol impregnated specimens and biometric analysis.

Key words: Hypotrichida, Amphiisiellidae, redescription, taxonomy, Korea

INTRODUCTION

Recently, the definition of the family Amphiisiellidae has been tried by several authors (Jankowski, 1979; Small and Lynn, 1985; Eigner and Foissner, 1994; Eigner, 1997). A puzzling case is the hypotrichs which have an obliquely extending "median cirral row" on the ventral surface between the right and the left marginal cirral rows. Such hypotrichous species are often assigned to the poorly defined family Amphiisiellidae. This "median cirral row" was re-evaluated by morphogenetic data, i.e. the median cirral row can be formed by at least four non-homologous processes. But this redefinition is insufficient to light up the supergeneric phylogeny of hypotrichs. Some other criteria, such as, molecular markers and morphogenetic processes at electron microscopic level appear indispensable for this purpose.

The amphiisiellid hypotrichs have not been studied from Korea. Two species of amphiisiellid hypotrichs were found from the soils of pine forest, mosses and grassland at the three localities in Kyonggi-do, Korea, during the collection period of 15 January 1992~4 April 1993. The cells

were cultured at the laboratory, impregnated with protargol and analyzed biometrically (Wilbert, 1975; Shin and Kim, 1994). The Korean populations are slightly different from the original European populations. It is needed to redescribe and elucidate the morphological variations of these species by the comparison with original descriptions of these species and some other related species, and on the basis of biometrical characterization of the species (Sokal and Rohlf, 1981).

RESULTS AND DISCUSSION

Phylum Ciliophora Doflein, 1901

Class Polyhymenophora Jankowski, 1967

Order Hypotrichida Stein, 1859

Family Amphiseliidae Jankowski, 1979

Genus *Amphisella* Gourret and Roeser, 1887

1. *Amphisella acuta* Foissner, 1982 (Fig. 1, Table 1)

Amphisella acuta Foissner, 1982, p. 35, figs. 2a-f, 42, table 5.

Material examined. Ten and 13 living specimens collected from the Kimpo-up (126° 40' 20" and 37° 30' 45" N), Kimpo-gun, 25 March 1993 and Tokchok Island (126° 00' 40" E and 37° 10' 20" N), Ongjin-gun, 15 January 1992, respectively, and nine protargol impregnated specimens were analyzed biometrically.

Description. General morphology and behavior: Body very soft and flexible, very slender and sigmoidal, twisted longitudinally, flattened dorsoventrally, ranging 110-170 μ m long and 20- 40 μ m wide *in vivo*; anterior end broadly round; posterior end slightly curved toward right and pointed like tail; ventral surface flattened and slightly concave; dorsal surface convex; middle parts of both margins parallel. Crawling movement rapid and its direction changing frequently.

Frontal and buccal fields: Four frontal cirri (FC) large and prominent, located at ventral surface of anterior most part. One buccal cirri (BC) slightly prominent and located at mid-point along paroral membrane. Adoral zone of membranelles (AZM) 16-22 μ m long with 14-16 prominent adoral membranelles (AM), covering approximately 14% of body length. Buccal field small, comprising undulating membrane (UM) of 11-17 μ m long. Pharyngeal fibers (PF) at base of buccal field extending to near right margin of body, and 10-20 μ m long.

Somatic infraciliature: One row of midventral cirri bearing 12-16 cirri, beginning at next to posteriormost FC and extending to middle of ventral surface. Both rows of left marginal and right marginal cirri (LMC and RMC) extending almost to posterior end and not confluent posteriorly; LMC beginning at region beneath cytostome, extending posterior end and bearing 30-35 cirri; RMC beginning near level of mid-point of undulating membrane and bearing 33-36 cirri; number of RMC more than LMC by two. Dorsal surface bearing almost 3 dorsal kineties (DK); mid DK with 12 - 18 cilia, cilia on dorsal surface bristle-like, approximately 4 μ m long, some of them more or less shortened. Three transverse cirri (TC) slightly prominent and located at ventral surface of posterior end.

Nuclear organelles with 18-35 macronuclei (Ma), 4-8 μ m long and 2-3 μ m wide, lying entire of body. Cytoplasm and pellicle colorless and almost transparent. Contractile vacuole spherical and

spindle like, positioning at middle of left margin of body.

Distribution. Austria and Korea.

Remarks. The present species is closely related to *Amphisiella raptans* Buitkamp and Wilbert, 1974, but distinguished from it by the following characteristics. (1) This species has about 24 macronuclei, while 8 in *A. raptans*. (2) This species has 4 frontal cirri while 7 in *A. raptans*. (3) The ventral cirri in this species extends to the middle of the ventral surface, while that of *A. raptans* to the posterior end of the ventral surface (Buitkamp and Wilbert, 1974; Foissner, 1982). The Korean population of this species are slightly different from original European population. Especially, Korean population has distinctly fewer in the numbers of both marginal cirri, ventral cirri and macronuclei than those of European population (Foissner, 1982). As a part of the

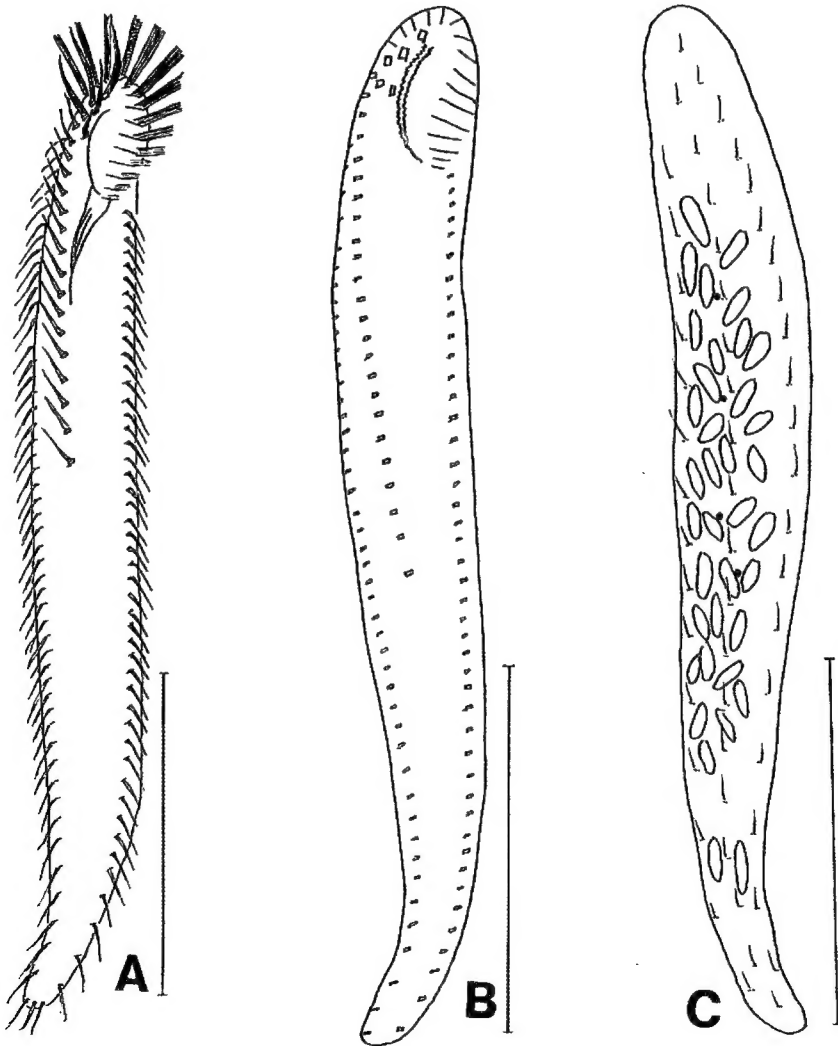


Fig. 1. *Amphisiella acuta* Foissner, 1982: A, living specimen, ventral view; B, infraciliature after protargol impregnation, ventral view; C, dorsal kineties and nuclear state, dorsal view (scale bars = 50 μ m).

biometrical data (Table 1), the coefficients of variation (CV) were calculated. The following characters showed the CV of 0.00: The numbers of frontal, transverse and buccal cirri. Thus these characters are found to be very constant and therefore considered as important diagnostic features of this genus. Comparatively low CVs ranging from 4.12 to 10.99 were shown in the following characters: the numbers of adoral membranelles, ventral cirri and both marginal cirri, and the length of adoral zone of membranelles, the ratio of UM/AZM-length and body-length/AZM-length. These characters are very important for identification of species because of their low variability. Other characters showed fairly high value of CV ranging from 14.55 to 40.00.

Genus *Orthoamphisiella* Eigner and Foissner, 1991

2. *Orthoamphisiella stramenticola* Eigner and Foissner, 1991 (Fig. 2, Table 1)

Orthoamphisiella stramenticola Eigner and Foissner, 1991, p. 131, figs. 1, 6-13, table 1.

Material examined. Ten living specimens collected from Namhansansong (127° 10' 10" and 37° 20' 50" N), Kwangju-gun, 4 April 1993 and 10 protargol impregnated specimens were analyzed biometrically.

Description. General morphology and behavior: Body very soft and flexible, elongate and rectangular, flattened dorsoventrally, ranging from 90–150 µm long and 35–60 µm wide *in vivo*; anterior and posterior ends slightly blunt and broadly round; ventral surface flattened and slightly concave; dorsal surface convex; right margin of body straight to slightly convex; left margin of body slightly indented beneath adoral zone of membranelles. Crawling movement rapid and its direction changing frequently.

Frontal and buccal fields: Three frontal cirri (FC) large and prominent, located at ventral surface of anterior most part; usually two rows of frontoventral cirri (FVC) located between row of buccal cirri (BC) and row of midventral cirri; first row of FVC bearing about three cirri and second four, sometimes third three. One row of buccal cirri (BC) bearing about three slightly prominent cirri, located at anterior-point along paroral membrane. Adoral zone of membranelles (AZM) 31 - 43 µm long with 22–28 prominent adoral membranelles (AM), covering approximately 32 % of body length. Buccal field small, comprising undulating membrane (UM) of 25–37 µm long. Pharyngeal fibers (PF) at base of buccal field extending to near right margin of body, and 15–23 µm long.

Somatic infraciliature: One row of midventral cirri bearing 17–27 cirri, beginning at next to anterior distal end of AZM and extending to middle of ventral surface. Left marginal cirri (LMC) and right marginal cirri (RMC) rows extending to posterior end and almost confluent posteriorly; LMC beginning at region beneath first to third AM, extending to posterior end and bearing 25–33 cirri; RMC beginning near level of mid-point of undulating membrane and bearing 24–37 cirri; number of RMC more than LMC by three. Dorsal surface bearing two dorsal kineties (DK); left dorsal kinety with 15–20 cilia, its last three cilia curved to left; cilia on dorsal surface bristle-like, approximately 4 µm long, some of them more or less shortened. Caudal and transverse cirri absent.

Nuclear organelles with four macronuclei (Ma), 9–15 µm long and 7–10 µm wide, three of them ellipsoidal and lying slightly left of median and anteriormost ones located slightly right of median one at level of buccal field; four micronuclei (Mi) spherical, located near macronuclear segments, about 1.5–2.5 µm in diameter. Cytoplasm filled with crystals and greasily shining 31–50 globules. Food vacuoles containing ciliates and testate amoebas. Contractile vacuole spherical, positioning

Table 1. Biometrical characterization of *Amphisiella acuta* (upper line) and *Orthoamphisiella stramenticola* (lower line). All data were based on protargol impregnated specimens. The abbreviations in the table are the same as in the description except statistical terms (Max.: maximum; Min.: minimum; SD: standard deviation; SE: standard error; CV: coefficient of variation in %; n: population size).

Characters	Mean	Median	Max.	Min.	SD	SE	CV(%)	n
Body length	137.11	143	160	105	19.95	6.65	14.55	9
	114.30	115	126	103	7.39	2.34	6.47	10
Body width	24.67	23	37	20	5.50	1.83	22.30	9
	49.50	50	56	38	5.62	1.78	11.36	10
Body length/width	5.70	5.50	7.35	4.14	1.05	0.35	18.39	9
	2.33	2.29	2.71	2.07	0.22	0.07	9.39	10
AZM length	19.22	20	22	16	1.92	0.64	10.00	9
	36.60	36.5	43	31	4.14	1.31	11.32	10
Body length/ AZM length	7.12	7.14	8.00	6.18	0.67	0.22	9.44	9
	3.15	3.12	3.74	2.51	0.33	0.10	10.53	10
UM length	14.33	14	17	11	2.18	0.73	15.21	9
	29.70	29	37	25	3.86	1.22	13.00	10
UM/AZM length	0.74	0.74	0.85	0.65	0.06	0.02	8.33	9
	0.81	0.81	0.9	0.74	0.05	0.02	6.37	10
Ma length	5.78	6	8	4	1.20	0.40	20.80	9
	12.40	12	15	9	1.71	0.54	13.81	10
Ma width	2.58	2.5	3	2	0.39	0.13	15.25	9
	8.10	8	10	7	1.07	0.34	13.27	10
Mi diameter	1.73	1.8	2	1.3	0.31	0.15	17.95	4
	2.15	2	2.5	1.5	0.34	0.11	15.70	10
Ma number	23.89	21	35	18	5.40	1.80	22.59	9
	4.00	4	4	4	0.00	0.00	0.00	10
Mi number	2.50	2	4	2	1.00	0.50	40.00	4
	3.80	4	5	3	0.63	0.20	16.64	10
DK number	3.29	3	4	3	0.49	0.18	14.85	7
	2.00	2	2	2	0.00	0.00	0.00	10
AM number	15.11	15	16	14	0.60	0.20	3.98	9
	24.00	23	28	22	1.94	0.61	8.10	10
BC number	1.00	1	1	1	0.00	0.00	0.00	8
	3.10	3	4	3	0.32	0.10	10.20	10
FC number	4.00	4	4	4	0.00	0.00	0.00	8
	3.00	3	3	3	0.00	0.00	0.00	10
VC number	14.22	15	16	12	1.56	0.52	10.99	9
	—	—	—	—	—	—	—	—
FVC number	—	—	—	—	—	—	—	—
	7.50	7.5	9	6	1.08	0.34	14.40	10

Table 1. Continued

RFVC number	-	-	-	-	-	-	-	-
	20.70	20.5	27	17	3.37	1.07	16.27	10
TC number	3.00	3	3	3	0.00	0.00	0.00	6
	-	-	-	-	-	-	-	-
LMC number	32.56	33	35	30	1.51	0.50	4.64	9
	29.30	29.5	33	25	2.41	0.76	8.21	10
RMC number	34.33	34	36	33	1.41	0.47	4.12	9
	31.40	31	37	24	3.53	1.12	11.25	10
Granule number	-	-	-	-	-	-	-	-
	39.60	40	50	31	6.88	3.08	17.37	5
PF length	16.71	19	20	10	3.59	1.36	21.49	7
	17.70	17.5	23	15	2.67	0.84	15.08	10

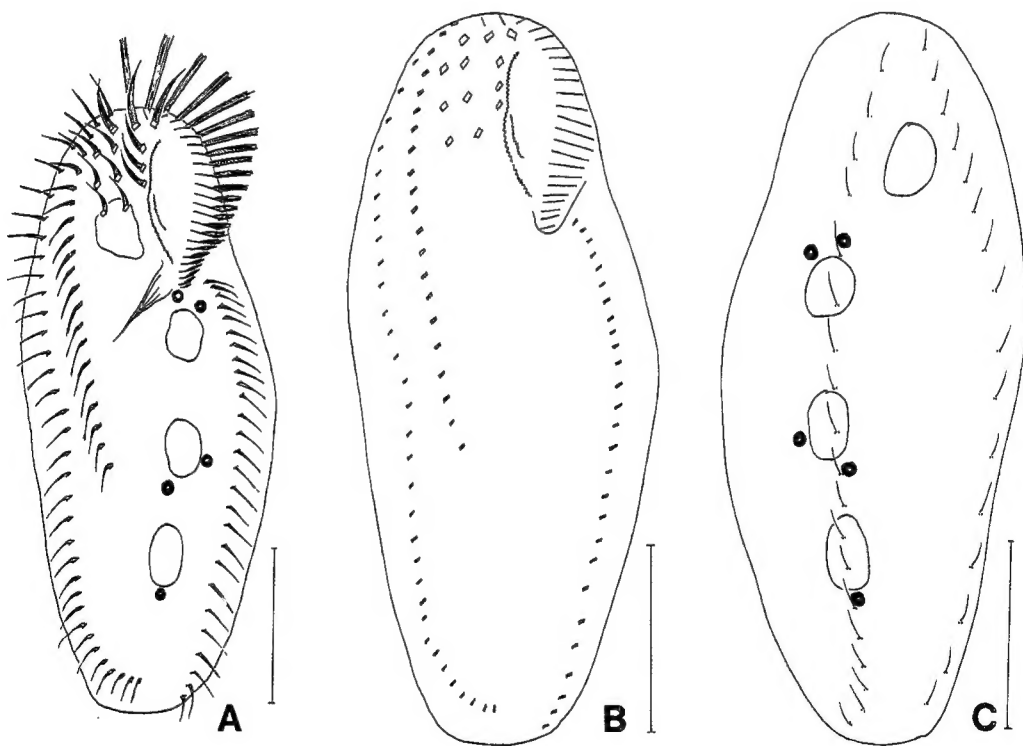


Fig. 2. *Orthoamphisiella stramenticola* Eigner and Foissner, 1991: A, living specimen, ventral view; B, infraciliature after protargol impregnation, ventral view; C, dorsal kineties and nuclear state, dorsal view (scale bar = 50 μ m).

near middle of left margin of body.

Distribution. Austria and Korea.

Remarks. Some species appear rather similar to this species when superficially observed, for example, *Hemiamphisiella quadrinucleata* (Foissner, 1984), *Amphisiella quadrinucleata* Berger and Foissner, 1989 and *Amphisiella vitiphila* (Foissner, 1987). The present species can be distinguished from each of the above three species by the following characteristics. (1) *Hemiamphisiella quadrinucleata* has caudal cirri, four dorsal kineties and no row of frontoventral cirri, while the present species has no caudal cirri, two dorsal kineties and 2-3 rows of frontoventral cirri. (2) *Amphisiella quadrinucleata* has transverse cirri and only one row of frontoventral cirri, while the present species has no transverse cirri and 2-3 rows. (3) *Amphisiella vitiphila* has transverse cirri, three dorsal kineties and three frontoventral cirri, while the present species has no transverse cirri, two dorsal kineties and 7-10 frontoventral cirri (Foissner, 1984, 1987; Berger and Foissner, 1989; Eigner and Foissner, 1991).

The characteristics of Korean population of this species are slightly different from those of European population. Especially, when compared to the European population, fewer amounts of the ventral cirri, frontoventral cirri, buccal cirri and both marginal cirri are observed but greater amounts of adoral membranelles are found from the Korean population (Eigner and Foissner, 1991). As a part of the biometrical data (Table 1), coefficients of variation (CV) were calculated. The following characters showed the CV of 0.00: The numbers of dorsal kinety, macronuclei and frontal cirri. Thus these characters are found to be very constant and therefore considered as important diagnostic features of this genus. Comparatively low CVs ranging from 6.37 to 11.25 were shown in the following characters: The numbers of adoral membranelles, buccal cirri and both marginal cirri, and the length of body, the ratio of body length/width, UM/AZM length and body length/AZM length. These characters are very important for identification of species because of their low variability. Other characters showed fairly high value of CV ranging from 11.32 to 17.37.

REFERENCES

- Berger, H. and W. Foissner, 1989. Morphology and biometry of some soil hypotrichs (Protozoa, Ciliophora) from Europe and Japan. *Bull. Br. Mus. nat. Hist. (Zool.)*, **55**: 19-46.
- Buitkamp, U. and N. Wilbert, 1974. Morphologie und Taxonomie einiger Ciliaten eines kanakischen Präriebodens. *Acta Protozool.*, **13**: 201-210.
- Eigner, P., 1997. Evolution of morphogenetic processes in the Orthoamphisiellidae n. fam., Oxytrichidae, and Parakahliellidae n. fam., and their depiction using a computer method (Ciliophora, Hypotrichida). *J. Euk. Microbiol.*, **44**: 553-573.
- Eigner, P. and W. Foissner, 1991. *Orthoamphisiella stramenticola* nov. gen., nov. spec., a new hypotrichous ciliate (Ciliophora: Hypotrichida) occurring in walnut leaf litter. *Acta Protozool.*, **30**: 129-133.
- Eigner, P. and W. Foissner, 1994. Divisional morphogenesis in *Amphisiellides illuvialis* n. sp., *Paramphisiella caudata* (Hemberger) and *Hemiamphisiella terricola* Foissner, and redefinition of the Amphisiellidae (Ciliophora, Hypotrichida). *J. Euk. Microbiol.*, **41**: 243-261.
- Foissner, W., 1982. Ökologie und Taxonomie der Hypotrichida (Protozoa: Ciliophora) einiger sterreichischer

- Böden. Arch. Protistenkd., **123**: 19-143.
- Foissner, W., 1984. Infraciliatur, Silberliniensystem und Biometrie einiger neuer und wenig bekannter terrestrischer, limnischer und mariner Ciliaten (Protozoa: Ciliophora) aus den Klassen Kinetofragminophora, Colpodea und Polyhymenophora. Stapfia, **12**: 1-165.
- Foissner, W., 1987. Soil protozoa: fundamental problems, ecological significance, adaptations in ciliates and testaceans, bioindicators, and guide to the literature. Progress in Protozoology, **2**: 69-212.
- Jankowski, A. W., 1979. Revision of the Hypotrichida Stein, 1859. Generic catalogue, phylogeny, taxonomy. Proc. Zool. Inst. USSR Acad. Sci., **86**: 48-85.
- Shin, M. K. and W. Kim, 1994. Morphology and biometry of two oxytrichid species of genus *Histiculus* Corliss, 1960 (Ciliophora, Hypotrichida, Oxytrichidae) from Seoul, Korea. Korean J. Zool., **37**: 113-119.
- Small, E. B. and D. H. Lynn, 1985. Phylum Ciliophora Doflein, 1901. In: Lee, J. J., S. H. Hutner and E. C. Bovee (eds), An illustrated guide to the protozoa. Society of Protozoologists, Lawrence, pp. 393-575.
- Sokal, R. R. and F. J. Rohlf, 1981. Biometry. Freeman and Co., San Francisco, 368 pp.
- Wilbert, N., 1975. Eine Vertesserte Technik der Protargolimpragnation für Ciliaten. Mikrokosmos, **64**: 171-179.

RECEIVED: 11 November 1998

ACCEPTED: 1 December 1998

한국산 양열하모충류 (Ciliophora: Hypotrichida: Amphisiellidae)

두 종의 재기재

신 만 균

(울산대학교 자연과학대학 생명과학부)

요 약

경기도의 세 지점의 소나무숲, 초원 및 이끼의 토양에서 채집된 하모류 중에서 양열하모충과의 두 종 *Amphisiella acuta* Foissner와 *Orthoamphisiella stramenticola* Eigner and Foissner가 한국에서 처음으로 밝혀져서 생체와 protargol로 염색한 표본에 근거하여 형질을 통계처리하고 재기재하였다.